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Goplana dioscoreae-alatae nom. nov. and other *Uredinales* on *Dioscoreaceae:* nomenclature and taxonomy *

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Abstract — Among the sixteen species of rust fungi described on *Dioscoreaceae*, three require replacement names. This paper re-describes and proposes *Goplana dioscoreae-alatae* as a replacement name for *Goplana dioscoreae* Cummins, nom. illegit. We also propose *Uredo dioscoreae-doryphorae* as a replacement name for *Uredo spinulosa* Y. Ono, nom. illegit.; and *Aecidium tumbayensis* as a replacement name for *Aecidium dioscoreae* J.C. Lindq., nom. illegit. We discuss nomenclatural controversies surrounding these taxa.

Key words — *Dioscorea*, winged yam, invasive

Introduction

Winged yam (*Dioscorea alata* L.) originated in continental tropical Asia. It produces large, edible tubers, and is an important source of the steroid diogenin, used in birth control pills. *Dioscorea alata* was introduced into the Americas and is considered an invasive vine in Florida, where it can produce stems up to 30 ft. long.

One of the most economically significant rusts on *Dioscorea* is *Goplana dioscoreae* Cummins (winged yam rust). This rust has been reported from Asia and Pacific Islands (Ono 1982) and is considered to be of quarantine significance as a potentially invasive species for the United States. As such, it is listed by the USDA Animal and Plant Health Inspection Service (APHIS) as a Regulated Plant Pest (under the anamorph name *Uredo dioscoreae-alatae*) (Cline & Farr 2006).

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Goplana currently includes at least twelve species described on hosts of *Asteraceae, Dioscoreaceae, Euphorbiaceae, Grossulariaceae, Lauraceae, Magnoliaceae, Meliosmaceae, Rubiaceae*, and *Vitaceae* (Cummins & Hiratsuka 2003). The three species known to occur on *Dioscorea* are *G. dioscoreae* with aparaphysate uredinia and 6–9 obscure scattered germ pores per urediniospore, *G. australis* Y. Ono & J.F. Hennen with (4–)6–8(–9) equatorial germ pores per urediniospore (Ono 1982), and *G. ecuadorica* Syd. with paraphysate uredinia (Ono & Hennen 1983).

Worldwide, eighteen species of rust fungi are known on *Dioscoreaceae*, all on the host *Dioscorea* except *Uredo dioscoreicola* F. Kern, Cif. & Thurst. on *Rajania cordata* (Kern et al. 1933). Diagnostic characters of the fifteen other *Dioscorea*-associated species (representing six other genera) are outlined briefly below.

Aecidium dioscoreae J.C. Lindq. and *A. leonense* Cummins have an *Aecidium*-type anamorph with peridial cells (Lindquist 1953), differing from the *Uredo*-type anamorph of *G. dioscoreae,* which lacks peridial cells.

Cerotelium dioscoreae Berndt can be distinguished by urediniospores with two equatorial germ pores (Berndt 1997) (contrasting with the 6–9 obscure scattered germ pores found in *G. dioscoreae).*

Phakopsora dioscoreae Thaung has peripheral paraphysate uredinia (Ono 1982), while those of *G. dioscoreae* are aparaphysate.

Puccinia dioscoreae Kom., *P. valida* Arthur, and *P. dioscoreae-mundtii* Berndt et al. all produce one-septate teliospores and urediniospores with two (*P. dioscoreae* and *P. valida*) or 4–5 germ pores (*P. dioscoreae-mundtii*) (Berndt and Uhlmann 2006). *Goplana dioscoreae* has non-septate teliospores and 6–9 obscure, scattered germ pores per urediniospore.

Sphenospora pallida (G. Winter) Dietel has been reported on several *Dioscorea* species (Jørstad 1956). The urediniospores in the uredinial stage (*Uredo dioscoreae* Henn.) are larger (20–)22–26(–29) × 19–22 µm than those in *G. dioscoreae* (17–28 × 14–22 µm).

Seven species of *Uredo* have been reported on *Dioscorea*: *Uredo dioscoreae-aculeatae* Racib. has bilaterally ovate urediniospores that are spiny on the convex surface and smooth on the lower surface, *Hemileia*-like (Ono 1982), while those of *G. dioscoreae* are evenly echinulate. *Goplana dioscoreae* urediniospores are sub-globose to ellipsoid and relatively small, in contrast to urediniospores that are obovoid, ellipsoid, or pyriform and 28–38 × 20–26 µm in *U. dioscoreae-filiformis* Racib.; obovoid, ellipsoid, pyriform to oblong, often angular and (19–) 21–35 (–37) × 14–22 (–23) µm (Ono 1982) in *U. dioscoreae-sativae* Syd. & P. Syd.; and oblong, ellipsoid to obovoid and 32–45 × 14–28 µm (Jørstad 1956) in *U. pallatangae* Jørst. *Uredo dioscoreicola* has 3–4 equatorial germ pores per urediniospore (Kern et al. 1933) and *U. xenoporula* P. Syd. & Syd. (Sydow & Sydow 1924) a single germ pore at the base of the spore next to the pedicel

in contrast to the 6–9 obscure scattered germ pores found in *G. dioscoreae*. *Uredo spinulosa* Y. Ono has abundant uredinial paraphyses (Ono 1982), while uredinia of *G. dioscoreae* are aparaphysate.

At present, only eight rust taxa on *Dioscorea* are known to occur in the western hemisphere: *Aecidium dioscoreae* J.C. Lindq., *A. leonense*, *Cerotelium dioscoreae*, *Goplana ecuadorica*, *Puccinia valida*, *Sphenospora pallida*, *Uredo dioscoreicola*, and *U. pallatangae*. No rusts on *Dioscorea* have been reported from Europe, but a number of rust fungi have been reported from Africa, Asia, and Oceania.

Materials and methods

Specimens of *Uredo dioscoreae-alatae* housed at the U.S. National Fungus Collection and Herbarium of the Institute of Botany, Jagiellonian University, were examined. Material was mounted in aqueous lactic acid and examined using a Zeiss Axioplan 2 microscope with bright field optics. Size ranges were based on at least 20 measurements for each structure. Authorities of fungal names are based on recommendations given in Authors of Fungal Names (CABI): http://www.indexfungorum.org/FungalNameAuthors.pdf.

Results and discussion

Taxonomy and nomenclature of *Goplana dioscoreae-alatae*

Goplana dioscoreae-alatae J.R. Hern. & E.T. Cline, **nom. nov**.

MycoBank 515307

≡ *Goplana dioscoreae* Cummins, Bull. Torrey Bot. Club 87: 35. 1960, nom. illeg., non (Berk. & Broome) Cummins 1935.

Anamorph (uredinial state):

Uredo dioscoreae-alatae Racib., Paras. Alg. Pilz. Java's 1: 29. 1900.

= *Aecidium dioscoreae* Berk. & Broome, Journ. Linn. Soc. Bot. 14: 95. 1873, non Lindq. 1953 [≡ *Aecidium tumbayensis* J.R. Hern. & E.T. Cline].

≡ *Uredo dioscoreae* (Berk. & Broome) Petch, Ann. Roy. Bot. Gard. Paranediya 5: 252. 1912, nom. illegit., non Henn. 1896 [anamorph of *Sphenospora pallida*].

≡ *Goplana dioscoreae* (Berk. & Broome) Cummins, Mycologia 27: 607. 1935 [anamorphic name in a teleomorphic genus].

= *Uredo dioscoreae-pyrifoliae* J.M. Yen, Rev. Mycol. (Paris) 34: 327. 1970.

Spermogonia and aecia unknown. Uredinia amphigenous, on petioles, caulicolous, deep-seated in host tissues, long covered by elevated, cupulate, thick, dark brown host tissue, erumpent by irregular central apertures, small, less than 1 mm diam., scattered or grouped in areas up to 5 mm diam., on dark leaf spots. Urediniospores pedicellate, sub-globose to ellipsoid, almost hyaline to pale yellow to pale chestnut-brown, 17–28 × 14–22 µm, wall echinulate, 2–3 µm thick; germ pores obscure, 6–9, scattered. Telia hypophyllous, minute, densely gregarious, subepidermal, erumpent, waxy and gelatinous when wet.

Teliospores in groups, on large, laterally free cells, cylindric, (46–)50–77 × 7–11 µm, walls thin, colorless; metabasidia form by continuous apical elongation of probasidial cells.

Type: on *Dioscorea alata*, near Manila, Luzon, **PHILIPPINES**, 2 Dec. 1912, *P.W. Graff* (Sydow, Fungi Exotici Exsiccati nº 230, as *Uredo dioscoreae-alatae*), PUR-F1270, Holotype, BPI 154672!, Isotype of *Goplana dioscoreae-alatae*. [The specimen includes both anamorphic and teleomorphic states, although only the anamorph was originally described under the name *Uredo dioscoreae-alatae*.]

Other specimen examined: on *Dioscorea alata*, Buitenzorg, **JAVA**, 1898, *M. Raciborski* (KRA-F 1898-43(J))! II, Type of *Uredo dioscoreae-alatae* (as *Uredo dioscoreae* on specimen envelope).

Hosts: *Dioscorea alata*, *D. bulbifera* L., *D. esculenta* (Lour.) Burkill, *D. pyrifolia* Kunth, *D. transversa* R. Br., and *Dioscorea* sp. (*Dioscoreaceae*).

Geographic distribution: Australia, Brunei, Indonesia, Java, Malaysia, New Caledonia, Pacific Islands, Papua New Guinea, Philippines, Singapore, Sri Lanka.

Nomenclatural comments — Cummins (1935) was the first to describe the teleomorphic (telial) state of this fungus, when he published the new combination *Goplana dioscoreae* (Berk. & Broome) Cummins. Cummins (1935) did not provide a Latin description of the teleomorphic state and thus failed to fulfill the requirements for valid publication of a sp. nov. (McNeill et al., 2006, Art. 36.1). Although some authors (Cummins 1960, Ono 1982, Ono & Hennen 1983) have listed "*Goplana dioscoreae*" Cummins 1935 as an invalid teleomorph name, this name cannot be treated as a teleomorphic sp. nov. and must be accepted as an anamorphic comb. nov. based on the type of *Aecidium dioscoreae* Berk. & Broome (McNeill et al., 2006, Art. 59.6).

In 1960, Cummins republished the name *Goplana dioscoreae* Cummins, this time providing a Latin description of the teleomorphic state and a teleomorphic holotypification. *G. dioscoreae* Cummins 1960 is therefore a validly published name for the teleomorph. Nevertheless, it cannot serve as the accepted name for the teleomorph, because it is an illegitimate later homonym of the anamorphic name *Goplana dioscoreae* (Berk. & Broome) Cummins (McNeill et al. 2006: Art. 59.6 Ex. 7).

No other legitimate name exists for the teleomorph of *Uredo dioscoreae-alatae*. We propose *Goplana dioscoreae-alatae* as a replacement name for the illegitimate later homonym *Goplana dioscoreae*.

New names and nomenclatural clarifications for *Uredinales* on *Dioscoreaceae*

Aecidium tumbayensis J.R. Hern. & E.T. Cline, **anam. nom. nov.**

MycoBank 515308

≡ *Aecidium dioscoreae* J.C. Lindq., Rev. Fac. Agron. 29(1a): 41. 1953, nom. illeg., non Berk. & Broome 1875.

Type: on leaves of *Dioscorea* sp. from **ARGENTINA**, Jujuy, Dpto. Tumbaya. Abra Grande de Volcán, 2900-3200 m, 23 January 1953, Sleumer 3551 (LPS 22259) I, Holotype.

Host: *Dioscorea* sp.

Geographic distribution: known only from the type specimen from Argentina.

Uredo dioscoreae-doryphorae J.R. Hern. & E.T. Cline**, anam. nom. nov.**

MycoBank 515309

≡ *Uredo spinulosa* Y. Ono, Trans. Br. Mycol. Soc. 79(3): 426. 1982, nom. illeg., non (Cooke) Sacc. 1891, nec Dietel 1897.

"*Uredo dioscoreicola*" Sawada, Trans. Nat. Hist. Soc. Taiwan 33: 98. 1943, nom. inval. [non *Uredo dioscoreicola* F. Kern et al. 1933].

Holotype: on *Dioscorea doryphora* Hance, Kusukusu, Takao, **TAIWAN**, Oct. 22, 1908, R. Suzuki (TS-R500. Mycological Herbarium of the Institute of Agriculture and Forestry, University of Tsukuba, Japan) (not seen).

Hosts: *Dioscorea doryphora* (*Dioscoreaceae*).

Geographic distribution: Taiwan. Known only from the type locality.

Nomenclatural comments — The initial description of this rust was by Sawada (1943), in Japanese, under the name *Uredo dioscoreicola*. Because Sawada did not provide a Latin description, the name was not validly published (McNeill et al. 2006, Art. 36.1). Ono (1982) proposed the name *Uredo spinulosa* to validate "*Uredo dioscoreicola*" Sawada. However, he inadvertently created an illegitimate later homonym of *Uredo spinulosa* (Cooke) Sacc. and *Uredo spinulosa* Dietel; thus no legitimate name currently exists for this rust, and we propose the replacement name *Uredo dioscoreae-doryphorae*.

Uredo dioscoreicola F. Kern, Cif. & Thurst., Ann. Mycol. 31: 24. 1933.

Holotype: on *Dioscorea altissima* Lam., from **DOMINICAN REPUBLIC**, La Vega, Cordillera Central, Bonao, at Río Maimón, 200 m, 17 Dec. 1930, *R. Cifferi & E.L. Ekman 3936* (BPI 847174) II!.

Hosts: *Dioscorea altissima*, *D. polygonoides* Humb. & Bonpl. ex Willd., *D. urophylla* Hemsl., *Dioscorea* sp., and *Rajania cordata* L. (*Dioscoreaceae*).

Geographic distribution: Brazil, Cuba, Dominican Republic, Panama, Puerto Rico, and Virgin Islands.

Nomenclatural comments — Arthur (1924) described Puerto Rican and Cuban specimens of a rust on *Dioscorea* that he identified as *Uredo dioscoreae* Henn. 1896. Kern et al. (1933) recognized that these collections had been misidentified, and published *Uredo dioscoreicola,* as an avowed nom. nov. to replace "*Uredo dioscoreae* Arthur, . . . not *Uredo dioscoreae* P. Henn." Stevenson (1975) continued to cite "*Uredo dioscoreae* Arth. . . . non P. Henn." as a synonym of *Uredo dioscoreicola*. However, Arthur (1924) clearly attributed the name *Uredo dioscoreae* to Hennings; he did not explicitly exclude the type of Hennings' name in his description, and therefore his use of the name *Uredo dioscoreae* must be interpreted as a broadening of Hennings' original species concept to include the collections from Puerto Rico and Cuba. There is no validly published name

"*Uredo dioscoreae* Arthur", and *Uredo dioscoreicola* must be treated as a sp. nov. (with no valid synonyms), and not as a nom. nov.

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